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Bilateral and multilateral processes between developed and developing countries and their progress towards achieving effective implementation of CCS

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Abstract

This paper aims at providing recommendations on how international cooperation on CCS can be improved. It analyses multilateral and bilateral processes with relevance to CCS, identifies gaps in these processes and provides recommendations for improvement. While an increase in these processes with relevance can be observed, there is a remaining need for international cooperation. Especially with respect to project financing and the legal framework development in countries, there is an increased need for international cooperation. Furthermore, bilateral initiatives between developed and developing countries primarily focus on China on the developing country side. These should be extended to other developing countries relevant for a successful international CCS role out.

Keywords: CCS, international climate policy, CO2, multilateral processes, bilateral processes

Introduction

The number of international organizations and countries working on CCS has grown over the last years [1]. Since the 1990s, when the IEA organized its first workshops on CCS, international organizations such as the CSLF were founded to address the issue or existing institutions started to include CCS into their scope. Important milestones were reached when the IPCC Special Report on CCS was published in 2005 [2] and when the G8 started to take up CCS at its Gleneagles meeting in 2008. The latter illustrates the increased awareness of the need to act at an international level as the G8 issued an indicative target of 20 "fully integrated industrial scale demonstration projects" by the end of 2010.

Countries have taken initiatives towards reaching this goal through planning and implementing demonstration projects [3]. Yet authors have pointed out that there is a need for more effective and coordinated international cooperation [1]. Recently, the IEA has reacted to this shortcoming and has published a roadmap that aims at facilitating an internationally coordinated rollout of CCS [4].

Under the UNFCCC developed countries have pledge fast start financing of 30 billion for the period 2010 to 2012 for mitigation and adaptation and 100 billion yearly by 2020 for mitigation. While it remains unclear what these financial flows from north to south will look like, the current financial pledges by countries seem to show that a large portion of the financial flows will be channeled through bilateral and multilateral institutions [5]. It is therefore also the aim of this paper to review how well current partnerships are prepared for this new opportunity.

This paper analyzes whether existing multi- and bilateral partnerships† fulfill the functions that are needed to foster the implementation of CCS worldwide. The analysis distinguishes between two types of partnerships: bilateral partnerships and multilateral. Within the scope of the paper the focus is on those partnerships that include both developed and developing countries.

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† For simplification we use the term partnership here to also refer to agreements, treaties, institutions or organisations. While these might be different concepts, we find it sufficient for this report to denote them all as partnerships, but intend not to make a judgment thereby.

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The paper presents an overview of these processes as well as identifies and analyses gaps within this current framework and attempts to provide some recommendations on how international cooperation on CCS can be improved. The work is based on a review of the internet presence of the partnerships as well as presentations held on the partnerships that were freely available in the internet.

Overview of current partnerships

For this paper, eleven bilateral and eleven multilateral partnerships were reviewed (see Table 1 and Table 3). For each initiative, the planned and implemented actions were categorized according to predefined fields of cooperation as defined within the IEA roadmap. These fields of cooperation are very broad and do not lend themselves fully to evaluate the current actions undertaken by the partnerships. Especially the field of technology includes as different works as desktop based studies, on-site research as well as feasibility studies. In order to be able to take account of such different types of activities, we also added a set of functions partnerships fulfill and assigned them to the fields of cooperation. This set of functions was derived in the course of the evaluation of the partnerships and closely corresponds with earlier sets of functions for CCS. Table 1 depicts these fields and functions together.

Table 1: Categorization of fields of collaboration

Fields as defined in the IEA Roadmaps	Functions derived for this study
Technology	Implementation of - desktop R&D - on site R&D - large scale projects Development of - feasibility studies - Roadmaps
Financing projects	Financing of - R&D projects - Large scale projects
Legal and Regulatory framework	- Regulatory framework development - Policy framework development
Public engagement and education	- Public engagement and education
International cooperation	- knowledge sharing and technology transfer - capacity building

Source: author's structure, [4]

Bilateral partnerships and their functions

Within this study three partnerships between the EU and China were identified (see Table 2). All of these solely focus on CCS. The centerpiece of the cooperation is the NZEC agreement. This project, headed by the UK on the EU side, consists of 3 phases, of which the first is already finished. Its ultimate goal is the deployment of a demonstration plant. COACH, the second big cooperation agreement, is already well advanced and aims at preparing the ground for a running demonstration plant by 2015. STRACO2, the third joint project, focuses primarily on regulatory issues within the EU but explicitly regards implementation issues for China.

For the US, two major partnerships with China were identified. All of the partnerships include CCS as one among other clean energy technologies. Until recently, the Fossil Energy Protocol, which focuses on promoting cooperation on fossil energy R&D, was the major focus of the China – U.S.

CCS cooperation. In 2009 the U.S. – China Clean Energy Research Center was established. The initiative is not yet implemented. Moreover, further partnerships between companies and other institutions in both countries exist. [6]

Australia is also involved in two major partnerships with China. The JCG focuses on the Capture side and endorses two demonstration plants, while the CAGS partnership deals with storage issues and includes joint research, technical workshops and summer schools. We identified one cooperation between Japan and China, which focuses on the implementation of an EOR project.

Table 2: Bilateral partnerships and their focus

		Technology					Legal and Regulatory framework		International cooperation		Public engagement and education	Financing projects	
Initiative Name	**Partnering countries**	**On site R&D**	**Desktop R&D**	**Feasibility studies**	**Large scale projects**	**Roadmaps**	**Regulatory framework**	**Policy framework**	**knowledge sharing**	**capacity building**	**Public engagement and education**	**On Site R&D projects**	**Large scale projects**
Cooperation Action within CCS China-EU (COACH)	EU - China		x	x	x	x	x	x	x	x	x		
Near Zero Emissions Initiative (NZEC)	EU (UK) + Norway - China		x		x	x		x	x	x			
STRACO2	EU - China						x	x					
U.S.-China Clean Energy Research Center	U.S. - China	x	x	x					x			x	
Fossil Energy Protocol	U.S. - China	x	x	x					x			x	
Climate Action Partnership (CAP)	Australia - China				x								
Joint Coordination Group on Clean Coal Technology (JCG)	Australia - China	x	x						x	x		x	
China Australia Geological Storage of CO2 (CAGS)	Australia - China	x							x	x	x	x	
CCS- EOR cooperation	Japan - China	x			x				x				
smaller initiatives - exemplary chosen													
-	UK - India									x			
South Africa CCS Centre	Uk- South Africa	x	x	x						x	x		

One particular aspect that stands out is that the majority of bilateral partnerships reviewed for this study focus on China. Essentially, each of the reviewed developed countries (including the EU) has at least one bilateral agreement with China. Tjernshaugen [7] finds a link between a country's interest in fossil fuels and its interest in CCS, which might help explain the focus on China. This does not fully explain this focus though, as bilateral agreements with other emerging economies,

such as India or South Africa, which are also heavily fossil fuel dependent, are limited. Other factors that might explain this focus are that China itself plans four CCS demonstration and full scale projects, while the rest of the developing world only plans two (South Korea and Algeria) [3]. The actions taken with countries other than China mainly focus on capacity building and feasibility studies. We did not come across any partnership with the group denoted as Least Developed Countries (LDCs) under the UNFCCC.

Furthermore, bilateral partnerships are often linked in some form to multilateral partnerships. One such example is the partnership between Australia and China. Both countries are at the same time represented in both the Asia-Pacific Partnership on climate change (APP) and the Global CCS Institute (GCCSI).

Multilateral partnerships and their functions

Our analysis found four groups of multilateral partnerships. The first group includes agreements with a broad scope but limited concrete actions. These include the MEF and the G8. The G8 sets an indicative target of 15 large-scale pilot projects worldwide by 2010, but provides no concrete guidance on how to reach them. The MEF provides general guidelines to their members in the form of a roadmap on how they can advance CCS, but includes no hard targets or concrete actions.

A second group of multilateral partnerships includes those with a sole focus on CCS. These include the CSLF and the relatively-new GCCSI. Although they tend to be relatively active, neither of the two partnerships have worked on concrete on-site research projects to date. The CSLF has mainly provided 'recognition' for projects from different fields of cooperation. The GCCSI aims at supporting on-site research but, to date, it has mainly funded an inventory of CCS projects around the globe as well as the work of other organizations, such as the IEA [8].

A third group are regional partnerships. The partnerships reviewed in this study are limited to the Asia-Pacific region and include the APP and the APEC. The APEC is divided into 8 task forces, one of which is the Cleaner Fossil Energy Task Force which includes CCS. The projects endorsed and implemented range almost across all fields of cooperation. The APP has an Expert Group on Clean Fossil Energy. Major fields of work include capacity-building on geological storage and guidelines for capture readiness.

A last group consists of international organizations working on CCS (UNIDO, IEA, IEA GHG, IEA Clean Coal Center, World Bank). Within this group, the IEA and its implementing programs (IEA GHG and IEA Clean Coal Center) have played the most significant role through their multiple publications and workshops. UNIDO and the World Bank have recently joined this effort by developing a roadmap (UNIDO) and initiating capacity-building workshops (World Bank).

The fields of cooperation of the multilateral partnerships are very similar to those within the bilateral partnerships analyzed. Exceptions are regulatory and policy issues; twice as many multilateral partnerships deal with these issues in some way or form compared to bilateral ones.

Table 3: Multilateral partnerships and their focus

Initiative Name	Technology					Legal and Regulatory framework		International cooperation		Public engagement and education	Financing projects	
	On site R&D	Desktop R&D	Feasibility studies	Large scale projects	Roadmaps	Regulatory framework	Policy framework	knowledge sharing	capacity building	Public engagement and education	R&D projects	Large scale projects
Asia Pacific Partnership on Clean Development and Climate Change (APP)	x	x	x	x	x	x		x	x		x	
Major Economies Process on Energy Security and Climate Change (MEF)								x				
Carbon Sequestration Leadership Forum (CSLF)	x	x						x	x			
Global Carbon Capture and Storage Institute	x			x		x		x		x	x	x
UN Industrial Development Organization					x				x			
International Energy Agency (IEA)						x	x	x	x			
IEA Greenhouse Gas R&D programme (IEA GHG)		x				x	x	x	x			
IEA Clean Coal Center	x	x						x			x	
G8 (Gleneagles meeting 2008)					x		x					
World Bank							x					
Asia Pacific Economic Cooperation (APEC)			x			x	x		x	x		

Gaps within current partnerships

In a second step, we analyze which topics are covered in the agreements and where gaps exist. The milestones, as formulated in the IEA Technology Roadmap for CCS [9];, [4], are used as a guide for this gap analysis. Every milestone formulated for the categories: Technology, Regulatory, Finance and Public Engagement, is extracted from the CCS Roadmap. Per milestone, the paper investigates the extent to which bilateral and multilateral partnerships include the specific milestones in their (work) program (Table 4).

Evaluation of bilateral partnerships

With respect to the *technology* milestone, most of the collaboration efforts are directed towards R&D and preparatory steps for large-scale demonstration plants. Bilateral initiatives with China mainly focus on CCS for coal-fired power plants. This is not surprising since coal-fired plants are at the heart of China's energy supply, and China's reliance on coal will become even stronger over the next decades [9]. The identification of industrial applications and biomass CCS is outside the scope of the bilateral initiatives.

Very few bilateral initiatives carry out *regulatory* studies. One of the reasons might be that regulatory frameworks are very country-specific and cannot easily be transferred to other countries. Our research finds that the regulatory work of existing bilateral initiatives is limited to general studies on the identification of issues to be solved if large-scale implementation of CCS should take place.

The actual *financing* of CCS pilot, demonstration or large scale projects and the arrangement funds is only covered to a very limited extend by current bilateral initiatives. Only some bilateral initiatives finance R&D efforts. Some initiatives, such as the EU NZEC project, have evaluated potential sources of financing for their planned large scale projects. There seem to be no projects though that finance large scale implementation.

Public acceptance studies are also not one of the main topics in bilateral initiatives. That effort is transferred to capacity-building events such as technical workshops, summer schools, symposia etc. It seems that awareness-building activities are often directed at policy makers and business leaders and not yet to local residents who might face the implementation of CCS in their surroundings.

Evaluation of multilateral initiatives

Multilateral initiatives often do not carry out *technical* research themselves, but have a function of governing or facilitating the progress made in this field and identifying new research areas. They serve as platforms for the exchange of knowledge and for identification and prioritization of research topics. The CSLF for example seeks collaboration and knowledge exchange on worldwide CCS projects by 'recognizing' CCS projects. Proposals for recognition can be submitted to the CSLF and are evaluated by the CSLF Technical Group. The GCCSI also closely follows the deployment of large scale CCS projects and reports on the status of these projects.

International collaboration mostly consists of knowledge exchange and networking and is an important element of most multilateral initiatives. Capacity building activities are often part of the initiatives.

The legal and regulatory framework is often dealt with in two ways. Either reports are written on regulatory issues (IEA GHG, IEA) or national governments are supported in their development of regulatory framework (GCCSI). The objectives with regard to regulatory issues are often not further specified than 'develop regulatory framework'.

There is only one multilateral initiative that is involved in *project financing*, the GCCSI. The Australian government committed AUD$100 million annual funding for the Global CCS Institute. Approximately AUD $50 million per annum will be made available to support a substantial portfolio of CCS projects around the world.

In general, multilateral initiatives are not involved in developing (local) communication strategies. If *public engagement* is part of their programme they look into public perception at a higher level.

Multilateral initiatives mostly serve a function of platform to exchange knowledge and to set priorities for research. Usually there are strong collaborative partnerships with other multilateral initiatives, e.g. GCCSI has strong linkages with the Energy Agency (IEA), Carbon Sequestration Leadership Forum (CSLF), World Bank, Asian Development Bank, Clinton Foundation and The Climate Group.

Table 4: IEA Roadmap Milestones and multilateral and bilateral programs

Research	Milestones according to IEA Roadmap	Focus multilateral programs	Focus bilateral programs
Technology	**2010 – 2020**: • Prove technologies at large scale • Reduce CO_2 capture energy penalty • Identify industrial applications • Demonstrate H_2 combustion with high-efficiency CCGTs • Demonstrate retrofit at 85% capture • Widespread availability of commercial plant (new and retrofit) • Fund R&D for biomass CO_2 capture • Reduce capital cost by at least 10% **2020 – 2030:** • All power plants operating over 45% efficiency (low heating value, including CO_2 capture) • Reduce capital costs by a further 10% • Demonstrate chemical looping for coal and gas, pressure and electrical swing absorption, cryogenics **2030 – 2050:** • Commercial systems with gas separation membranes • Continue to reduce energy penalty	APP: research on different capture technologies, cooperation around various capture pilots CSLF: Foster collaborative research, development, and demonstration (RD&D) projects reflecting Members' priorities. - GCCSI: funding and support program for large scale CCS projects in the critical stages of project development and implementation. - IEA Clean Coal Centre: support for relevant R&D by providing archives and databases + financial support - EGCFE: a.o. capture readiness	- COACH: coal gasification for appropriate poly-generation schemes with CCS - NZEC: coal fired power generation - FEP: feasibility of CCS with direct coal liquefaction (DCL), research 1+2: DOE funds cooperative work between West Virginia University and Shenhua Group Corporation - Joint Coordination Group on Clean Coal Technology (JCG): research 1: post-combustion capture pilot project, IGCC trial, research 2: general research collaboration - CCS-EOR cooperation: research 1/deployment: CCS capture and CCS storage in EOR field
Legal and Regulatory framework	**2010 – 2020**: • Regulatory frameworks in place for CCS demonstration • Comprehensive regulatory frameworks in place for commercial deployment **2020 – 2050:** • Continue to review and refine legal and regulatory frameworks in all regions as CCS experience increases	- APP: regulatory infrastructure development - MEF: Develop comprehensive legislative and regulatory frameworks that address, among other things, long-term storage and financial liability - GCCSI: Supporting national government in the development	- COACH: regulatory issues is a cross-cutting issue, identification of regulatory barriers for development and implementation of CCS - emphasizing appropriate solutions - STRACO2: is designed to support the development of a

		of regulatory frameworks - IEA: through reports - IEA GHG: through reports	regulatory framework for CCS in the European Union and to research possibilities of using EU CCS regulation as a best-practice study for CCS regulation in China.
Financing projects	**2010 – 2020**: • Provide an average of USD 3.5 – 4 billion annually for CCS demonstration projects • Provide USD 1.5 – 2.5 billion annually for CCS demonstration in non-OECD countries **2020 – 2050:** Continue to monitor and adapt CCS financing strategies as experience increases	- GCCSI: funding and supporting large-scale CCS projects in the critical stages of project development and implementation.	
Public engagement and education	**2010 – 2020**: • Provide greater governmental resources • Develop and apply a toolkit of best practice public engagement techniques to CCS demonstration projects **2020 – 2030:** • Refine public engagement strategies in all regions as CCS experience increases	- GCCSI: facilitating engagement with GCCSI (Foundation) Members, industry and governments in promotion of CCS - EGCFE: social perceptions and acceptance	- South Africa CCS centre: awareness and public outreach (generally planned) - CAGS: awareness building through Study tour for policy maker and business leader

Conclusions

Generally, an increase in international collaboration on CCS can be observed in recent years through new multilateral institutions such as the Global Carbon Capture institute or new bilateral partnerships such as the U.S. – China Clean Energy Research center. However, there is still significant room for further international efforts to advance the collaboration for CCS.

The bilateral agreements examined here primarily focus on technology-related issues and much less on other aspects such as regulatory aspects and public acceptance. An increase in cooperation on such issues might be beneficial in the future. It would enable to address the matter in a more concrete manner than currently done within multilateral partnerships. Within bilateral partnerships, e.g. national circumstances for the implementation of regulatory regimes could be better taken into account. Outcomes of resulting studies can therefore be much more applied and allow learning experiences which could then be transferred to the international level.

Since most of the bilateral initiatives analyzed in this paper are co-operations with China, the focus of the bilateral partnerships examined is even more narrow and limited to research on coal-fired power plants. In line with the IEA roadmap, partnerships should be extended to also include CCS from industrial processes and biomass. Especially the interest of countries playing an active role with respect to CCS in the international climate negotiations, such as Saudi Arabia, could be better taken account of in this manner. This also points to another short-coming of current bilateral partnerships: As they focus on China they leave out many other opportunities in other countries. However there is a large potential for CCS within other regions in the world, and within the climate negotiations some industrialized countries (e.g. the EU) have already stated regional preference for regions other than China [5])

Furthermore, project financing seems to play a rather minor role within current bilateral and multilateral partnerships for CCS. With the view on the current financial pledges laid out under the UNFCCC, bilateral and multilateral partnerships should start to increase their action within this field.

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